

## King Fahd University of Petroleum & Minerals

### Department of Mathematics and Statistics

#### Syllabus of Math 325 (201)

(Course Instructor: Dr. O. Echi; Office: 5-201-4; Tel: 18026; email: [echi@kfupm.edu.sa](mailto:echi@kfupm.edu.sa))

**Course:** Math 325

**Title:** Linear Algebra

**Textbook:** Serge Lang, *Linear Algebra, 3rd Edition (Springer), 1987.*

**Description:** Theory of vector spaces and linear transformations. Direct sums. Inner product spaces. The dual space. Bilinear forms. Polynomials and matrices. Triangulation of matrices and linear transformations. Hamilton-Cayley theorem.

**Prerequisite:** Math 225

#### Schedule

Week	Date	Section	Material
1	Aug 30-31 Sep 1-3	1.1 1.2	<b>(I). Vector spaces:</b> Definitions Basis
2	Sep 6-10	1.3 1.4	Dimension of a vector space Sums and Direct Sums
3	Sep 13-17	3.2 3.3	<b>(II). Linear Mappings:</b> Linear Mappings The Kernel and Image of a Linear Map
4	Sep 20-22	3.4 4.1	Composition and Inverse of Linear mappings <b>(IV). Linear Maps and Matrices:</b> Linear Map Associated with a Matrix
5	Sep 27- 30, Oct 1	4.2 4.3	Matrix Associated with a Linear Map Bases, Matrices and Linear Maps
6	Oct 4-8	5.1 5.2 5.4	<b>(V). Scalar Products and Orthogonality:</b> Scalar Products Orthogonal Bases, Positive Definite Case Bilinear Maps and Matrices
7	Oct 11-15	5.5 5.6	General Orthogonal Bases The Dual Space and Scalar Products
8	Oct 18-22	5.7 5.8	Quadratic Forms Sylvester's Theorem
9	Oct 25-29	7.1 7.2	Symmetric Operators Hermitian Operators
10	Nov 1-5	7.3 8.1	Unitary Operators <b>(VIII). Eigenvectors and Eigenvalues:</b> Eigenvalues and Eigenvectors
11	Nov 8-12	8.2 8.3	The Characteristic Polynomial Eigenvalues and Eigenvectors of Symmetric Matrices
12	Nov 15-19	8.4 8.5	Diagonalization of a Symmetric The Hermitian Case
13	Nov 22-26	8.6 9.1	Unitary Operators <b>(IX). Polynomials and Matrices:</b> Polynomials
14	Nov 29-30, Dec 1-3	9.2 10.1	Polynomials of Matrices and Linear Maps <b>(X). Triangulation of Matrices and Linear Maps:</b> Existence of Triangulation
15	Dec 6-10	10.2	Theorem of Hamilton-Cayley
16	Dec 13 Dec 14		Catch-up

**Course Learning Outcomes:** Students should be able to prove basic results of linear algebra and demonstrate a rigorous understanding of its basic concepts, including

1. the structure of vector spaces and linear transformations
2. the role of matrices as representations of linear transformations
3. bilinear maps and quadratic forms
4. inner product spaces, Hermitian and unitary operators
5. eigenvalues and eigenvectors
6. diagonalization and triangulation
7. polynomials of matrices and linear maps.

### **Exams and Distribution of Marks:**

Exam I (15%): Material: From Section 1.1 to Section 3.4, **Time: October 03, 2020.**

Exam II (15%): Material: From Section 4.1 to Section 5.4, **Time: October 24, 2020.**

Exam III (15%): Material: From Section 5.5 To Section 7.3, **Time: Nov. 21, 2020.**

Exam IV (15%): Material: From Section 8.1 To Section 8.6, **Time: Dec. 05, 2020.**

Final Exam 25% (Comprehensive): Time TBA.

Homework and Oral quizzes (15%): **Homework to be submitted by e-mail every Sunday.**

**Attendance:** Students are expected to attend all lecture classes.

- If a student misses a class, he is responsible for any announcement made in that class.
- **A DN grade will be awarded to any student who accumulates either 6 unexcused absences in lecture classes or 10 excused and unexcused absences in lecture classes.**